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HISTORY OF ENDEMIC HAWAIIAN BIRDS

Part I. POPULATION HISTORIES--SPECIES ACCOUNTS
Sea Birds: Hawaiian Dark-rumped Petrel ('Ua'u)

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ABSTRACT

Pterodroma phaeopygia sandwichensis is a stout, medium-sized petrel with light underparts and, except for a white forehead, dark upperparts. It was first described in 1884. Exhaustive search uncovered some 192 observations, collection records, reports and related statements on relative abundance and geographical distribution from 1862 to 1978. All data are arranged in geographical and chronological order and systematically analyzed. Distribution at-sea and outside expected range (extra-limital) are given. Numbers of island records are shown by U. S. Geological Survey quadrangle. References and names of observers are cited. Completeness of data, erroneous and doubtful records are addressed. Findings are summarized. Substantial colonies once known on Kaua'i, Moloka'i, Lāna'i, and Hawai'i were found to have disappeared. It is concluded that the long-term natural survival of P. p. sandwichensis depends essentially upon maintaining the vitality of the largest remaining subpopulation, that within Haleakala National Park (on Maui).

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2. Pterodroma phaeopygia sandwichensis
 'Ua'u or Hawaiian Dark-rumped Petrel
 (a subspecies of Dark-rumped Petrel)

The 'Ua'u or Hawaiian Dark-rumped Petrel (Pterodroma phaeopygia sandwichensis) is one of two subspecies; the other, P. p. phaeopygia, breeds exclusively in the Galapagos Islands. King (1967) and Berger (1972) give general descriptive accounts of the 'Ua'u, describing it as a large, 16-inch long, stout gadfly petrel with dark grey upperparts, including nape and rump, white underparts, and short wedge-shaped tail. The 'Ua'u may be distinguished most easily from the 'A'o (Puffinus puffinus newelli)--the only other similar inland breeding species--by its white, rather than black forehead. Like the 'A'o, the 'Ua'u flies over land only at night, nesting from May to October in burrows in the mountains, sometimes many miles from the sea. Kjargaard (1978) provides a detailed historical summary of the 'Ua'u within Haleakala National Park on Maui, the largest population now extant. An account of the breeding biology of P. p. phaeopygia in the Galapagos is given by Harris (1970). A comprehensive biological investigation of the 'Ua'u has yet to be conducted. Most of a total of 72 specimens located in a recent world-wide survey of museums were found in the Los Angeles County Museum (25), Bernice P. Bishop Museum (24), and American Museum of Natural History (8) (Banko 1978 ms.).

OBSERVATIONS, REPORTS, AND SPECIMEN RECORDS

Drawing conclusions from a large volume of historical information on relative abundance and distribution of 'Ua'u required that data be geographically arranged and chronologically ordered in a systematic fashion, as outlined in the Introduction to Part I (CPSU/UH Avian History Report 4). Records presented in Appendix I satisfy criteria necessary for basic documentation and comparative analysis.

In the following descriptive account, sources of published information are cited by author and year in the usual style. One, two, or three digit numbers in parentheses refer to specific records in Appendix I. Sources of published and unpublished information listed in Appendix I may be traced to complete references in the bibliography.

Early Records (1875-ca.1917):

Perkins (1903) seems to have been the only observer to comment on the relative abundance and distribution of 'Ua'u in the early days. He called this bird "common in many parts of the

islands, nesting in the high mountains, where it forms large colonies," also noting that "the young were formerly killed in great numbers by the natives" for food (1).

Kaua'i

The 'Ua'u was described by R. Ridgway (in Baird et al. 1884) from one of two specimens collected by V. Knudsen on Kaua'i (4). Knudsen obtained another specimen from an unspecified locality, presumably on Kaua'i, about 1886 (Banko 1978 ms.) (5). Munro (1941) tells of F. Gay and W. Deverill finding eggs on Kaua'i in April and May (6, 8), and of himself taking specimens and observing 'Ua'u flying up over the ridges towards the mountains near Kakapua, in 1895 (13).

Moloka'i

Except for information which may yet be retained in memories of old residents, virtually all we know today of 'Ua'u on Moloka'i was noted by Bryan (1908, 1914) during a series of visits there in 1907 and 1914. During one or the other of these trips, Bryan recorded specimens collected, colonies present, or individuals heard at Pelekunu (16, 18-22), Oloku'i (17, 25-28), Wailau (23, 24, 29), Moanui (32), and Hālawa (31). In a 1974 letter to me, N. Pekelo confirmed the former existence of 'Ua'u at Hālawa and added Makukooniki (islet) to the localities reported to be frequented by 'Ua'u in early days (30).

Lāna'i

The sole information on 'Ua'u breeding colonies on Lāna'i in early times was passed along by Munro (1941, ca. 1960 ms.) who told of specimens collected and birds known by Henry Gibson, presumably before 1911 when Munro began residing there, in the following localities: north end of the mountain and in the dry forest at the northwest end of the island (34); Kānepu'u forest, on ridges at the head of Maunalei, and above Waiapaa (35).

Maui

Knowledge of breeding localities of 'Ua'u before 1901 on Maui are limited to an account by Finsch (1880) of finding a few old holes and an old dried up white egg on the way from Olinda to the summit of Haleakalā in 1879 (44), and information passed along by C. Thompson and Harry Gibson (probably same person as Henry Gibson) to J. S. Medeiros of recollections of 'Ua'u being taken from burrows (for food) in the Polipoli area in 1900 and along the rim of Haleakala Crater from 1905 to 1910 (45, 46).

Hawai'i

The earliest mention of 'Ua'u on the island of Hawai'i seems to be that of Lyons (1875) who, 100 years ago, stated that the sole privilege of capturing 'Ua'u belonged to landowners, in Hāmākua in this case (154). Richardson and Woodside (1954), N. Santos, Shallenberger (1977), McCoy and Gould (1977) found bones of 'Ua'u in lava caves on middens of ancient Hawaiians at widely spaced locations on Mauna Loa, Mauna Kea, and Hualālai, many miles from breeding grounds known today, providing evidence of the extensive populations which may once have existed during the historic period (106, 159, 159a, 172, 173).

Early day records and reports of 'Ua'u on Hawai'i are more numerous than from any other island. Wilson and Evans (1894) obtained downy young of the 'Ua'u from a native Hawaiian at Kīlauea in 1887 and was told that a considerable number nested in holes in the vicinity, particularly on the slopes of Mauna Loa (130). Munro (1941) passed the carcass of an 'Ua'u lying on the trail at ca. 4500 feet elevation in the land of Hōnaunau, Kona, on 16 November 1891 (107). Henshaw (1902) secured an 'Ua'u specimen from M. Newell which had been found washed up on the beach at Hilo on 20 November 1890 (175). Henshaw was told by native Hawaiians in the 1894 to 1902 period that 'Ua'u formerly nested in great numbers in the lava between Mauna Loa and Mauna Kea (174) and that they were common on a fishing ground some 5 to 10 miles off windward Hawai'i (179). Though H. C. Shipman, a resident of the Hilo area since 1892, had never seen 'Ua'u himself, he recalled as a lad his mother telling him of native Hawaiians claiming different caves or nesting areas, presumably in the mountains, for capturing young for food (177). W. H. Meinecke accurately imitated the call of an 'Ua'u which he said represented a bird he heard occasionally at night as a boy near his home in Wai'ōhinu before the turn of the century, the species that older residents reported to him as nesting in numbers at nearby Pali Puāao before destruction of the area in the great earthquake of 1868 (123).

Later Records (ca.1917-1978):

Munro (1941, 1944), well aware of the history of 'Ua'u disappearance in the islands, stated nearly 40 years ago that this bird was in danger of extinction.

Kaua'i

There seems to be only one positive record of 'Ua'u on the island of Kaua'i since those of the 1890's, a specimen picked up by T. C. Telfer on 8 December 1968 at the beach near Kapa'a and confirmed by J. L. Sincock (12).

Lāna'i

On Lāna'i, G. C. Munro found remains of 'Ua'u at Kaiholena Gulch and Ha'alelepa'akai in 1926 (36-38). S. L. Montgomery and R. J. Shallenberger recovered an 'Ua'u which landed near their lantern on the night of 26 October 1973 above Kaiholena (Shallenberger 1974) (39), and Hirai (1978) heard night-calling birds at Kumoa Gulch and between Pu'u Kīlea and Ha'alelepa'akai Puhielele Ridge during June and July 1976 (40-42).

Maui

Reports of 'Ua'u on Maui, all originating from Haleakala National Park, began in the 1930's. Crater-wide surveys initiated in the late 1960's suggest that this population has been the largest known to the present time. Kjargaard (1978) reported that T. Rodrigues, Jr., and CCC personnel heard petrels in Haleakala Crater in the 1930's which hindsight now indicates were probably those of 'Ua'u (47), and that calls continued to be noted by C. McCall, Jr., and other NPS Rangers in the late 1940's (48). Bonsey (1951) reported many night-calling petrels, no doubt 'Ua'u, at Kapalaoa and Hōlua from 7 July to 11 September 1951 (49). Richardson and Woodside (1954) recorded numerous 'Ua'u from above Hōlua Cabin, in the central crater area, above Kapalaoa Cabin, and a live juvenile (no doubt a crashed Haleakalā youngster) obtained by J. S. Medeiros near Kahului (50-55). Scattered specimens were salvaged and night-calling birds heard in Haleakalā from 1957 to 1964 by Carpenter (1959a, 1959b), L. N. Huber, W. V. Ward, W. B. King; and by Park biologists G. C. Ruhle, Dunmire (1961), and other NPS personnel (56-72).

Systematic searching for 'Ua'u nest burrows was begun in 1965 to 1966 by J. W. Larson who located 15 holes and estimated 100 pairs of 'Ua'u nesting in the Kapalaoa area and 300 pairs at Leleiwi and Kalahaku (cliffs) (74, 75). Night-listening and day-time burrow searches since 1967 by J. Kunioki, W. B. King, K. Buxbaum (1973), and J. I. Kjargaard gradually increased estimates of 'Ua'u breeding in Haleakala Crater. The estimate of 1600 ± 500 , including juveniles, by Kjargaard (1978) is the last and highest (76-91).

The first disabled 'Ua'u on Maui was reported by Richardson and Woodside (1954), as previously noted (50). In 1976 two crashed adults in the Lāhainā area and six fallen juveniles in Wailuku and Kahului were found (93-100). Inquiry would no doubt reveal that other 'Ua'u have been salvaged on Maui in recent years.

Hawai'i

No information was found in the literature or field notes indicating that 'Ua'u existed on the flanks of Kohala, Hualālai, or North Kona slopes of Mauna Loa during the historical period, 1778 to 1978 (101-104, 108, 109). The remains of a single bird reported by Munro (1944) lying on a trail at 4500 feet elevation in Hōnaunau in 1891 remains the sole evidence of 'Ua'u presence along Mauna Loa's lower South Kona slopes, as previously noted (107).

On the Ka'ū flank of Mauna Loa small numbers of 'Ua'u have been found at widely scattered locations. I began systematic searching of the Southwest Rift of Mauna Loa in 1968 and turned up persistent night-calling in three locations: on a 5536 feet elevation unnamed volcanic complex 0.75 mile southeast of Pu'u Ohohia (108); on Pu'u Keokeo at 6875 feet elevation 2.75 miles uprift (119); and on a volcanic complex about 1.5 miles down the Southwest Rift from Pu'u Keokeo (120). However, nest burrow(s) were discovered at only two sites characterized by persistent night-calling (108, 119). Listening at other locations along the Southwest Rift of Mauna Loa at night resulted in hearing little or no calling (113-118, 121-122).

The possibility that 'Ua'u once nested at Pali Puāao near Wai'ōhinu, Ka'ū, developed during an interview I had with W. H. Meinecke. Although residents of Wai'ōhinu who are now deceased had traditionally credited Pali Puāao (cliff of the 'A'o) with being a breeding ground of 'A'o (Puffinus puffinus newelli), Meinecke accurately imitated the night-calling of 'Ua'u when describing the sound he heard near his childhood home in Wai'ōhinu in the 1890's. Meinecke was unfamiliar with the physical appearance of either the 'A'o or 'Ua'u. It is therefore possible that it was the 'Ua'u that nested at Pali Puāao, or that both species nested there. The historical record is thus confused (123).

Records of 'Ua'u on the windward slopes of Mauna Loa are confined to Hawaii Volcanoes National Park and vicinity. 'Ua'u were not detected by P. C. and/or W. E. Banko at the summit crater of Mauna Loa, nor at Pu'u'ula'ula along the summit trail on the Northeast Rift at 10,000 feet elevation; however, feathers and bones have recently been found and presence revealed along the Mauna Loa summit trail at ca. 8000 feet elevation by C. Corn (S. Conant, pers. comm.); M. Fontes, and K. Nishimoto; and P. Conant, and S. Nagata (S. Conant, pers. comm.) (125-129). Although native Hawaiians supplied S. B. Wilson with downy young at Kīlauea in 1887, and indicated that 'Ua'u nested in considerable numbers in the vicinity, and more particularly on the slopes of Mauna Loa (130), reconnaissance in the Kīlauea area by W. B. King, Morrison (1967) (Hatch 1967), and me, turned up mostly negative results (135-137, 139, 146). While I heard a few calls on 7 September 1972 at Makaopuhi Crater, and P. H. Baldwin

(Banko, pers. comm.) thought it possible a relict population there may have been previously overlooked, no calls were heard under poor listening conditions on 6 August 1978 (147, 148, 150). The possibility of 'Ua'u breeding at Makaopuhi therefore presently lacks confirmation.

There is ample evidence that 'Ua'u frequent the Kīlauea area, mostly in November, although one record each exists for May, October, and December. During the 31 year period 1948 to 1978, some 10 disabled birds, many recently fledged, have been reported or recovered (J. H. Hansen; D. Forbes; van Riper III [1978 ms.]; Baldwin & Hubbard [1949]; D. W. Peterson; S. Linderer; J. P. Lockwood) mostly as a result of crashes around the well-lighted Volcano House and Kīlauea Military Camp (131, 132, 140, 142-145), but also at the USGS Volcano Observatory (141), near erupting Mauna Ulu (149), and along the Belt Highway near the 47 milepost about 7 miles southwest of the Park boundary (138). Reports of birds calling at night in the Kīlauea area have never been positively identified as those of 'Ua'u by persons familiar with the vocalizations of this species, and at least some reporting error has been acknowledged (133-137). There is a possibility that some calling reported to be that of 'Ua'u may have been that of the White-tailed Tropicbird (Phaethon lepturus dorotheae) which I have heard vocalize in flocks on stormy nights from March to May in the Kīlauea area, at least before the 5 November 1967 to 13 July 1968 eruption of Halema'uma'u when the population which lived on the crater walls was much greater.

On the northeast flank of Mauna Loa, outside Hawaii Volcanoes National Park, one disabled 'Ua'u found near the Kūlani Project, 5500 feet elevation, was salvaged as a specimen by an unknown party on 28 November 1954 (Banko 1978 ms.) (112). J. P. Lockwood heard persistent night-calling at an unnamed 7996 feet elevation volcanic cone on 28 July 1976 (110).

In addition to previously mentioned archaeological evidence of 'Ua'u populations once-resident on Mauna Kea, reported by Richardson and Woodside (1954) (159), and McCoy and Gould (1977) (159a), there are a number of observations indicating that remnant groups have persisted until recently. Richardson and Woodside also reported a dead carcass found near Kanakaleonui on the east slope of Mauna Kea; five fresh burrows located at 8800 feet elevation near Pu'u Kōle on the southeast slope; remains of three 'Ua'u picked up by H. Fergerstrom at over 9000 feet elevation (above Pu'u Kōle); and discovery of feathers and part of a beak at ca. 10,000 feet elevation on the south flank (155, 158). Walker (1962) heard one calling near Kaluamakani Cabin (151). A few years later, in 1968, I picked up an old 'Ua'u wing at the State Division of Forestry cabin below Kanakaleonui, and in 1969 identified a dried-up carcass brought to me by N. Santos as that of an 'Ua'u (167). In 1969 I queried construction foreman N. Crapo relative to possible night-calling heard or carcasses

encountered in Crapo's daily commuting from Hale Pōhaku to the telescope construction site on the summit of Mauna Kea during 1968 and 1969, but he knew nothing of such a bird (163, 164). During the 1968 and 1970 breeding seasons I carried out several wide-ranging night listening surveys along jeep trails on the upper east, northeast, north, northwest, and west slopes of Mauna Kea, including particularly the Pu'u Kōle and Kanakaleonui areas (161, 162, 165, 166, 170, 171). A single rush of wings and a few calls heard at 1935, 1942, 1950, and 2015 hours on 2 June 1970 near Kanakaleonui were the only positive results obtained during five nights of work (168, 169).

Distribution At Sea

Other than the Henshaw (1902) report that native Hawaiians in the 1890's observed 'Ua'u to be common on a fishing ground some 5 to 10 miles offshore windward Hawai'i (179), little of substance was recorded of the pelagic distribution of the 'Ua'u until the Smithsonian Institution conducted the Pacific Ocean Biological Survey Program in the middle and late 1960's. Trained biologists in this program recorded distribution and relative abundance of all species of sea birds during 3561 hours of observation on 15 cruises along a predetermined replicated sampling track of 34,384 miles in the general vicinity of the Hawaiian Islands. From information collected on these cruises, King (1970), who reported results of the work, concluded that 'Ua'u were widespread over the 500,000 square mile study area and doubtlessly ranged beyond survey parameters in all directions. Individuals were identified as far north as 42°N and as far south as 5°N latitude; as far east as 148°W and as far west as 158°W longitude (181-184). One density center was found in the northwest corner of the study area, near latitude 25°N, longitude 157°W (180). 'Ua'u were also seen by R. S. Crossin in early morning hours in company with 'A'o (Puffinus puffinus newelli) near the island of Kaua'i (King, pers. comm.), and there were many instances recorded of 'Ua'u flying directly toward or away from Kaua'i (185,186).

S. Tokumine, skipper of the fishing boat Kaimamala out of Hilo, reported to me that 'Ua'u were present in Hawaiian waters (from South Point, island of Hawai'i to French Frigate Shoals, Northwestern Hawaiian Islands) from May to October, and were absent from about November to April (187).

Extra-limital

There seems to be only one 'Ua'u of record that has been collected on an island outside the Hawaiian Islands. A specimen from the Molucca Islands in the Southwest Pacific suggested to King (1967) the possibility of a migration to the Western Pacific during the non-breeding season (188).

COMPLETENESS OF DATA, ERRONEOUS AND DOUBTFUL RECORDS

The foregoing records on relative abundance and geographical distribution of 'Ua'u are believed essentially complete for the sources examined, from 1884 until the contemporary period.

Attention is drawn to several erroneous or doubtful records. Henshaw (1902), lacking specimens, felt "reasonably sure" that night-calling birds which invaded Hilo on stormy nights during the fall and winter months were 'Ua'u (176). Baldwin (1946, 1952) expressed a more recent similar belief (178), and passed along a report of Mr. Nakamura that he saw a small flock near Malamakī (Puna District) (178, 124). Passage of time and lack of corroborating reports or other evidence tend to cast doubt on the validity of these records.

Morrison (1967) corrected his mistaken impression of hearing 'Ua'u in the vicinity of the Volcano House (136, 137). There seems sufficient negative evidence from other surveys (135, 139), and lack of a single positively identified 'Ua'u heard at Kīlauea over the years by me or others to discount the validity of Dunmire's (1960) and Eisenmann's (1961) reports also.

Munro (1941) reported that he found five pairs of 'Ua'u wings on Lāna'i on 11 September 1896, but gave the year as 1926 in an unpublished manuscript (33, 20). The wings, clearly labeled 11 September 1926, are in the Bernice Pauahi Bishop Museum, Honolulu, establishing 1926 rather than 1896 as the actual year of collection.

The report of Warner (1968), of sea birds grounded along the windward beaches of Kaua'i during the summers of 1960 and 1961, confused the identity of 'A'o (Puffinus puffinus newelli) with that of 'Ua'u (R. E. Warner, pers. comm.). Circumstantial evidence and lack of further similar incidents involving 'Ua'u on Kaua'i supports Warner's subsequent belief that the birds seen both years were 'A'o, not 'Ua'u as stated.

CHRONOLOGICAL DISTRIBUTION OF RECORDS

Of the 192 existing 'Ua'u records, 187 were classified according to decade of origin and compiled in Table 1. The numbers in the table exhibit the initial observations following description of the species in the 1880's, the comparative absence of reports from early 1900's through the 1930's, and steady buildup of information from 1940's through the 1960's and 1970's.

TABLE 1. Distribution of 192 'Ua'u records by decade.

1770's -	1840's -	1910's -	3
1780's -	1850's -	1920's -	3
1790's -	1860's -	1930's -	1
1800's -	1870's -	1940's -	8
1810's -	1880's -	1950's -	20
1820's -	1890's -	1960's -	73
1830's -	1900's -	1970-8 -	50

GEOGRAPHICAL DISTRIBUTION OF RECORDS

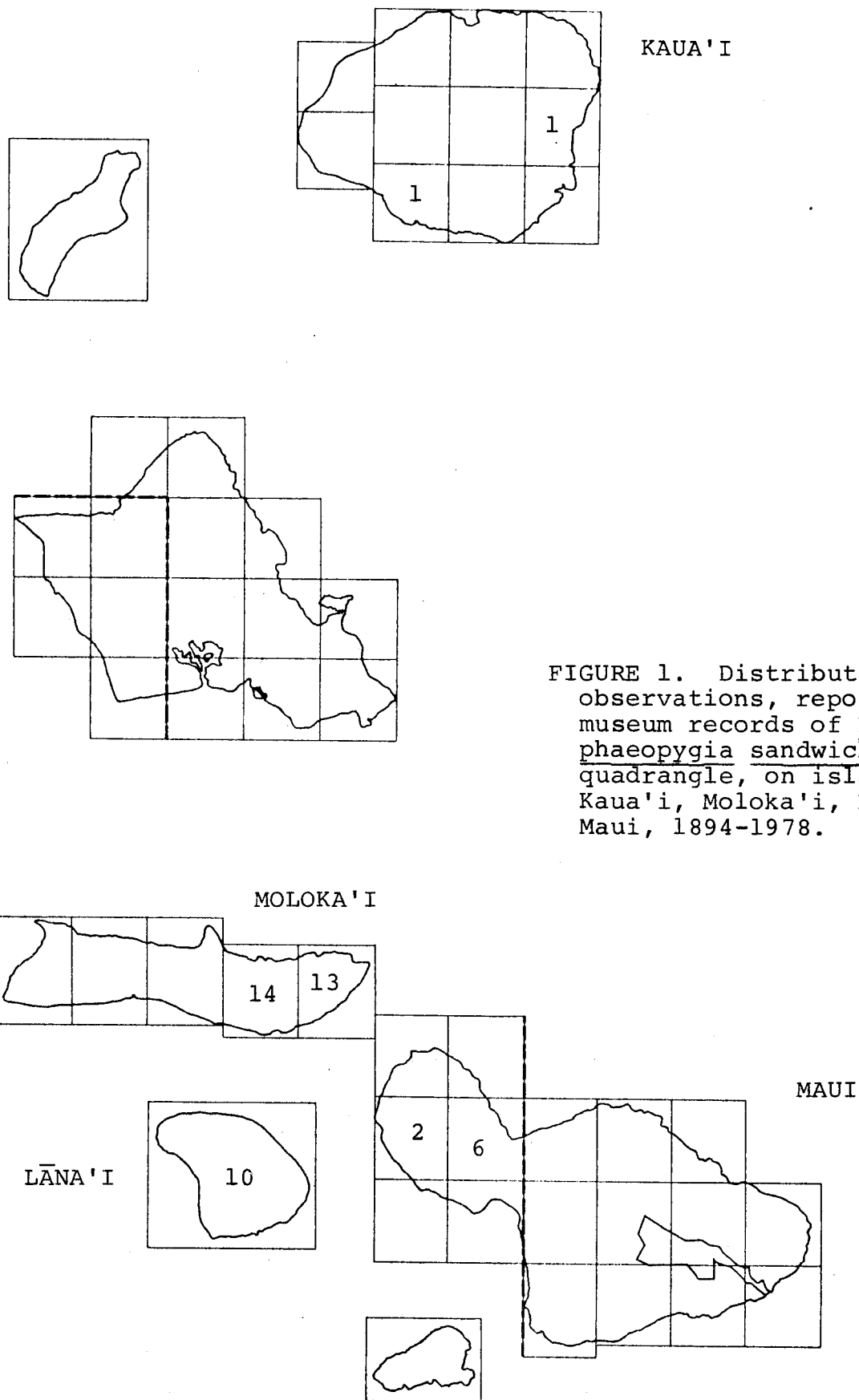
Distribution of all positive observations, reports, and specimen records--except at-sea and extra-limital records--are shown for each quadrangle for the islands of Kaua'i, Moloka'i, Lāna'i, and Hawai'i in Figures 1 and 2. There seem to be no records of 'A'o occurrence on Ni'ihau, O'ahu, and Kaho'olawe, the small offshore islets of the five major islands (except for Maku-kooniki off Moloka'i), or on the Northwestern Hawaiian Islands.

SUMMARY

The 'Ua'u or Hawaiian Dark-rumped Petrel (Pterodroma phaeopygia sandwichensis) is one of two subspecies characterized by comparatively large size, dark-grey upperparts, white underparts, and short wedge-shaped tail. It nests from May to October in the Hawaiian Islands, flying over land only at night to nest in burrows sometimes many miles from the sea.

The history of 'Ua'u on the island of Kaua'i is comparatively short. Specimens were collected in the 1880's in undescribed localities and the species was noted in the 1890's breeding in the mountains. Except for the recovery of one grounded 'Ua'u, presumably a straggler, picked up near the beach at Kapa'a in 1968, none have been reported on Kaua'i since 1895 when the last breeding residents were recorded.

Nothing seems to be known of the occurrence of the 'Ua'u on the island of Moloka'i before 1907 or after 1914. W. A. Bryan found colonies and/or collected specimens at Pelekunu, Oloku'i, Wailau, Moanui, and Hālawā. N. Pekelo also reported 'Ua'u to be



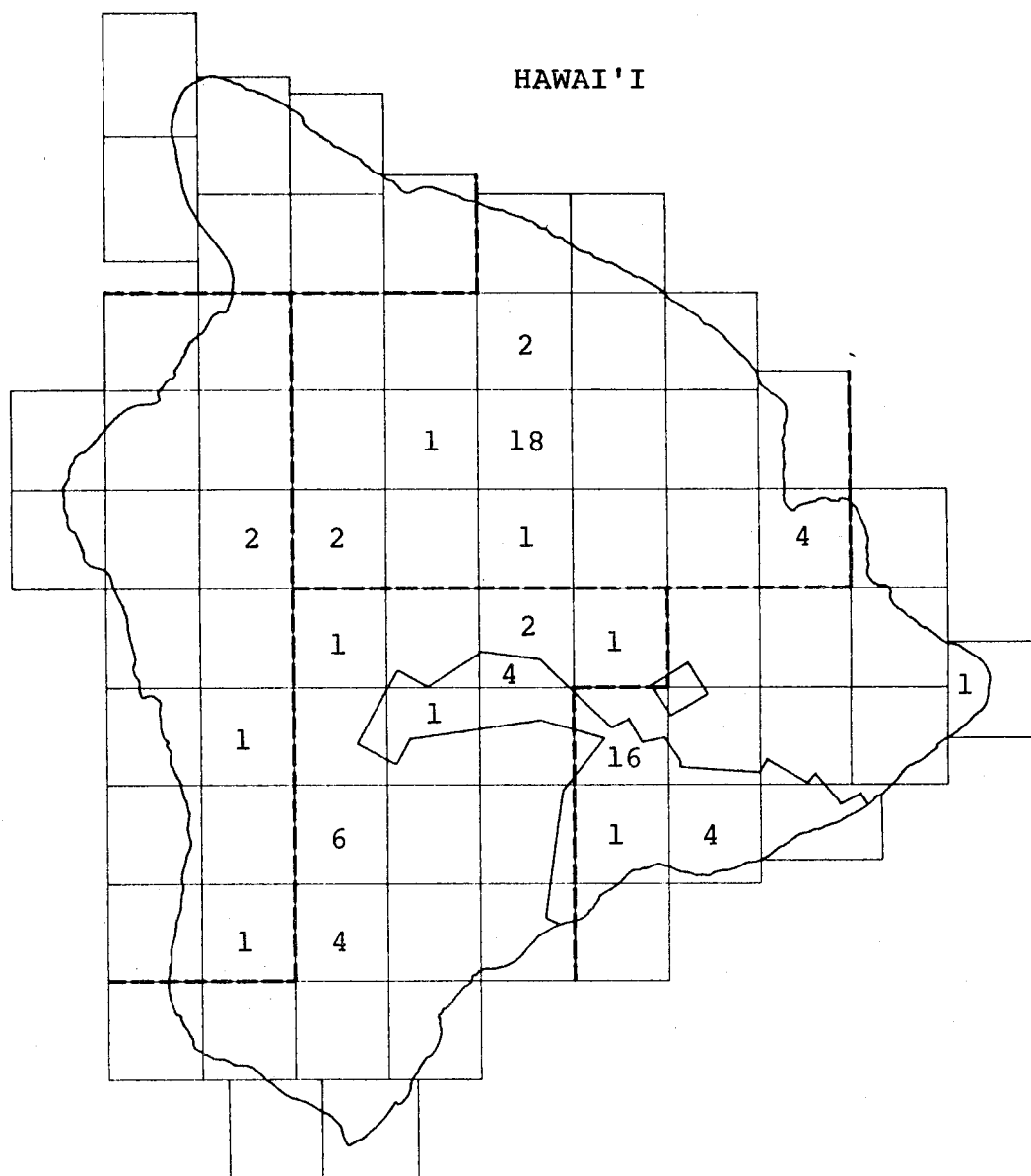


FIGURE 2. Distribution of observations, reports, and museum records of Pterodroma phaeopygia sandwichensis, per quadrangle, on Island of Hawai'i, 1894-1978.

formerly present on Makukooniki (islet), according to old residents of the area he talked with.

G. C. Munro noted that 'Ua'u were found on Lāna'i in the early days at the north end of the mountain, in the dry forest at the northeast end of the island, Kānepu'u forest, on ridges at the head of Maunalei, and above Waiapaa. Remains of a few birds were found in 1926 at Kaiholena and Ha'alelepa'akai. Night-calling birds heard in 1976 by L. T. Hirai at Kumoa Gulch and between Pu'u Kīlea and Ha'alelepa'akai Puhielelu Ridge appear to represent the last remnant stocks extant.

The history of 'Ua'u on Maui is confined to Haleakalā where there is one early record of a breeding group on the outside flank of the volcano, in 1879. All other observations of 'Ua'u at Haleakalā are confined to the crater where an estimated 1600±500 currently nest along the rim and steep interior cliffs. Individuals from this population, the largest extant, have recently been known to occasionally crash at night near bright lights in the Wailuku, Kahului, and Lāhainā areas.

Records and reports of 'Ua'u on the island of Hawai'i are more numerous than from any other island. Breeding colonies on Mauna Kea, Mauna Loa, Kīlauea, and in the lava fields between Mauna Kea and Mauna Loa were patronized by native Hawaiians in the late 1880's who captured 'Ua'u for food. There is growing archaeological evidence that 'Ua'u had a much greater earlier distribution on the island of Hawai'i than historical records indicate. Small breeding colonies have persisted until recent times high on the eastern slopes of Mauna Kea, near Pu'u Kole and Kanakaleonui. The only known breeding group extant on the island of Hawai'i is a small scattered group which nests on the Southwest Rift of Mauna Loa. Another small scattered population may exist in or near Hawaii Volcanoes National Park and/or along the flanks of the northeast Rift where recent indications have been found. A few individuals, presumably from this windward Mauna Loa group, have been crashing at night in the Kīlauea area for over 30 years.

'Ua'u are not known from O'ahu, Ni'ihau, Kaho'olawe, or the Northwestern Hawaiian Islands.

The 'Ua'u may be found at sea from May to October in off-shore waters up to hundreds of miles distant from the main Hawaiian Islands. It is largely absent in the Hawaiian Island environment during the winter months and its wintering grounds are not yet known. A single 'Ua'u specimen recovered in the Molucca Islands in the Southwest Pacific furnishes a possible clue as to direction and duration of migration during the non-breeding season.

CONCLUSIONS

The 'Ua'u was a breeding resident of Kaua'i but disappeared sometime after 1895 before the size and location of colonies were described. On Moloka'i, breeding colonies were known at five locations but these vanished sometime after 1914. Five 'Ua'u colonies were reported to have existed on Lāna'i in the late 1800's and/or early 1900's, but only a few individuals have been heard calling at two locations in recent years. On the island of Hawai'i, extensive breeding colonies of 'Ua'u existed in the late 1800's on Mauna Kea, Mauna Loa, lava fields between these two volcanoes, and Kīlauea. All except one small scattered group on the Southwest Rift of Mauna Loa and possibly a similar population on or near the Northeast Rift appear to have disappeared. The largest and most intact breeding group of 'Ua'u now extant is the 1600±500 which nest on the steep crater walls of Haleakalā. It is unlikely that future surveys will turn up the existence of another group even 10% of the size of the Haleakalā population. The lack of many crashed individuals in other than already known or suspected breeding localities does not encourage hope that substantial populations remain to be discovered. Given the history of disappearance of breeding 'Ua'u in the Hawaiian Islands, it is clear that long-term natural survival of the 'Ua'u is essentially dependent upon the vitality of the population in Haleakala National Park.

OBSERVERS

Paul H. Baldwin, Paul C. Banko, Winston E. Banko, Richard C. Banks, William A. Bryan, Patrick Conant, Carolyn Corn, Norman Crapo, Richard S. Crossin, William Deverill, Harry Fergerstrom, Michael Fontes, Donald Forbes, Francis Gay, Douglas E. Gill, Thelma H. Hadley, John H. Hansen, Lawrence N. Huber, Warren B. King, John I. Kjargaard, Valdemar Knudsen, Jitsumi Kunioki, James W. Larson, Roxie C. Laybourne, Steven R. Linderer, Jack P. Lockwood, Clifford McCall, Joseph S. Medeiros, William H. Meinecke, Steven L. Montgomery, George T. Morrison, George C. Munro, Stephanie Nagata, Mr. Nakamura, Kenneth Nishimoto, Noah K. Pekelo, Jr., Donald W. Peterson, Monty Richards, Theodore Rodrigues, Jr., George C. Ruhle, Nelson Santos, Robert J. Shallenberger, Herbert C. Shipman, John L. Sincock, Gerald E. Swedberg, Charles Thompson, Shigeru Tokumine, Charles van Riper III, Ronald L. Walker, Allen Wall, William V. Ward.

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APPENDIX I

1. Observations, reports, and specimen records are organized by island group, island, district, and/or quadrangle map. Order of listing, names and locations of district, and quadrangle boundaries are explained and illustrated in CPSU/UH Avian History Report 4: Introduction to Part I, Population Histories--Species Accounts.
2. Acronyms composed of the first three letters of the author's (or senior author's) last name, the initial letter of the first name, and last two digits of the year of publication represent sources found in the bibliography under References Cited. For example, BRYW01 = Bryan, W. A., and Alvin Seale. 1901. Notes on the birds of Kauai. Bishop Museum Occ. Papers. 1(3): 129-137. In cases where it is necessary to distinguish between two or more articles published by an author in any given year, letters are added to the acronym in alphabetical sequence, e.g., BRYW01a = Bryan, W. A. 1901. A key to the birds of the Hawaiian group. Bishop Museum Press. 76 pp.

Parenthetical numbers such as (5), represent references listed under Unpublished Sources Cited in the bibliography.

3. Place-names are cited in original form.
4. Parenthetical information is qualified.

Relative Abundance/Locality	Elev. (ft.)	Date	Source
Southeastern Hawaiian Islands			
ISLANDS-WIDE INFERENCE			
1 common...forming large colonies; young formerly killed in great numbers (by the natives for food) / in many parts of the islands, nesting in the high mountains	(1892-1896)	PERR03
2 in danger of extinction / nested in the mountains of Hawaii, Maui, Molokai, Oahu, Kauai, Lanai	(1944)	MUNG64
Island of Kaua'i			
ISLAND-WIDE INFERENCE			
3 Swedberg: King never heard ('Ua'u) call / (night island-wide surveys for 'A'o)	(27 Oct. 1966)	(21)
UNDESIGNATED LOCALITY			
4 Banko: species described from two specimens	1884	(7)
5 Knudsen: collected specimen	(1886)	RIDR87
6 Gay: lays eggs in April, May	1891	MUNG41
7 specimens in Gay and Robinson collection at Kekapua, Makaweli	1891	MUNG41
8 Deverill: nests in mountains	1891	MUNG41
9 Banko: specimen obtained (?Munro)	2 Feb. 1895	(7)

MULTIQUADRANGLE

- | | | | | |
|----|---|------|----------------|--------|
| 10 | Hadley: large numbers observed and reported / grounded along the windward beaches | .... | Summer of 1960 | WARR68 |
| 11 | large numbers observed and reported / grounded along the windward beaches | .... | Summer of 1961 | WARR68 |

KAPAA

- | | | | | |
|----|---|------|-------------|------|
| 12 | Sincock: Telfer picked up one alive (have no other observations...nor heard anything resembling its call) / at the beach near Kapaa | | 8 Dec. 1968 | (23) |
|----|---|------|-------------|------|

HANAPEPE

- | | | | | |
|----|--|------|--------|--------|
| 13 | could be seen...flying up over ridges towards the mountain...shot specimen 2 July 1895 / Kekapua, near residence (Kekupua) | | (1891) | MUNG41 |
|----|--|------|--------|--------|

Island of O'ahu

ISLAND-WIDE INFERENCE

- | | | | | |
|----|-------------------|------|--------|--------|
| 14 | know of no record | | (1941) | MUNG41 |
|----|-------------------|------|--------|--------|

Island of Moloka'i

ISLAND-WIDE INFERENCE

- | | | | | |
|----|---|------|--------|------|
| 15 | HSFG: thought to be extinct or extirpated | | (1969) | (19) |
|----|---|------|--------|------|

Island of Moloka'i--(Continued)

KAMALO

21

16	specimen collected...in the long grass / not far back of village (Pelekunu)	....	(1903/1904)	BRYW08
17	hunters secured 63 birds / (on the almost vertical cliffs of Olokui)	3500- 4000	(1907)	BRYW14
18	heard one calling / near Pelekunu Village	....	27 April (1907)	BRYW08
19	heard in sufficient numbers...secured spec- imens / Kaunuohua trail on pali into Pelekunu Valley	....	9 May (1907)	BRYW08
20	found bill, wings, feet and some loose feathers / Kaunuohua trail on pali into Pelekunu Valley	3500	9 May (1907)	BRYW08
21	colonies present / seldom less than 1500 ft. above the sea (Pelekunu)	....	(1907)	BRYW08
22	occasionally...found in same colony...on rare occasions in the same hole (as 'A'o) / (Pelekunu)	....	(1907)	BRYW08
23	Banko: Bryan collected 16 specimens / Wailau	....	6-14 June 1907	(7)
24	found half-eaten carcass / on the way over the Pali from Mapulehu to Wailau	....	14 June (1907)	BRYW14
25	21 specimens taken in six hour hunt with dogs (63 in 1906 under similar circum- stances) / on the almost vertical cliffs of Olokui	3500- 4000	14 June (1907)	BRYW14
26	found remains of 3 birds / ascending trail up Olokui	....	June (1907)	BRYW14

- | | | | | |
|----|---|------|-------------------------|-----|
| 27 | Banko: 26 collected by Bryan / Olokui
(valley) | | 20 July 1914 | (7) |
| 28 | Banko: Bryan collected five specimens /
Olokui | | 20 July 1914 | (7) |
| 29 | Banko: Bryan collected two specimens /
Wailau | | 14 June 1917
(?1907) | (7) |

HALAWA

- | | | | | |
|----|---|------|-------------------|--------|
| 30 | Pekelo: formerly taken by residents of
Halawa / cliffs above Halawa and on
Makukooniki (islet) | | undated | (18) |
| 31 | none seen or heard while camped / at Halawa | .... | (10-15 May, 1907) | BRYW08 |
| 32 | numbers seen, 3 specimens taken / Moanui...
flying over the headlands close down beside
the sea | | 5-6 June (1907) | BRYW14 |

Island of Lana'i

- | | | | | |
|----|--|------|---------------|--------|
| 33 | found the remains of five pairs of wings
evidently of adult birds of this species /
along an unused trail in the bottom of
Kaiholena valley | | 11 Sept. 1896 | MUNG41 |
| 34 | Henry Gibson: frequented ridges...nested
...when a boy / at the north end of the
mountain and also in the dry forest on the
northwest end of the island | | (1941) | MUNG41 |
| 35 | Munro: used to nest according to Henry
Gibson / in the Kanepuu forest, on ridges at
the head of Maunalei and above Waiapaa | | (1960) | (20) |
| 36 | Munro: found...5 pairs of wings / on a
little used trail in the Kaiholena Gulch | | 1926 | (20) |

Island of Lana'i--(Continued)

37	Banko: wing specimens from five salvaged by Munro / Kaiholena (gulch)	....	11 Sept. 1926	(7)	23
38	Munro: found...remains of one / at Haalelepaakai	....	1926	(20)	
39	Montgomery & Shallenberger: one landed below lantern...heard no calling / along Munro jeep trail above Kaiholena (gulch)	2700	26 Oct. 1973	SHAR74	
40	night calling heard suggests probable population of 50 / along 0.25 mile stretch of Munro Trail (jeep road), Kumoa Gulch	2800	23 June; July, Aug., Sept. 1976; 29 May 1977	HIRL78	
41	negative results from listening surveys / Kanepuu	....	June, July 1976	HIRL78	
42	listened for calls with only sporadic or negative results / 5 locations along Munro Trail between Puu Kilea and Haalelepaakai Puhielelu Ridge	....	June 1976	HIRL78	

Island of Maui

UNDESIGNATED LOCALITY

43	Banko: Medeiros picked one up	15 Oct. 1955	(7)	
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Haleakala National Park

44	reported to breed; found a few old holes under the ferns, and an old dried-up white egg / outer slopes of Haleakala (on way from Olinda to summit)	(July 1879)	FINO80	
45	Medeiros: Thompson recalled retrieving young from burrows / Polipoli area	....	1900	(8)	

46	Medeiros: Harry Gibson recalled his mother being in parties from Kaupo which collected young birds / along rim of Haleakala Crater	....	1905-1910	(8)
47	Rodrigues and other CCC personnel: heard / Haleakala	....	1930's	KJAJ78
48	McCall and other Park Rangers: saw and heard / Haleakala	....	late 1940's	KJAJ78
49	(unidentified petrels) numerous / Kapalaoa and Holua at night; over the sea (?Hana)	....	7 July-11 Sept. (1951)	BONH51
50	live specimen in juvenile plumage picked up by Medeiros / reservoir near Kahului (Pukalani?)	....	22 Oct. 1953	RICF54
51	several seen in flight...one obtained from two burrows / quarter mile S of the Holua Cabin	....	8 June (1954)	RICF54
52	partial skeleton found / in central crater (Haleakala)	....	(5-9 June 1954)	RICF54
53	found tracks...apparently exploring for burrows / next to lava flows in the floor of the crater (Haleakala)	....	(5-9 June 1954)	RICF54
54	numerous bird calls and other notes heard from first night on / above the Holua Cabin region near the W floor of the crater	....	(5-9 June 1954)	RICF54
55	numerous bird calls and other notes heard from first night on / above the Kapalaoa Cabin which is below the S rim of the crater	....	(5-9 June 1954)	RICF54
56	NPS: carcass found / near the summit of Haleakala	....	May 1957	(2)
57	heard after dark / Holua cabin	....	7 Mar. 1959	CARR59a

Island of Maui--(Continued)

Hale Nat'l. Park (con't.)

58	NPS: Ruhle saw one / Haleakala Crater Overlook	....	10 April 1959	(2)
59	one seen / along trail to Kapalaoa Cabin	....	27 Oct. 1959	CARR59b
60	NPS: one seen / near the base of Puu Nole cinder cone	....	Oct. 1959	(2)
61	NPS: evidence found / along the cliffs above Holua Cabin	....	19 April 1960	(2)
62	many nest in the walls of the crater / behind Kapalaoa and Holua Cabins...best places to hear them at night	....	(1961)	DUNW61
63	Ward: recordings made / above Kapalaoa Cabin 800 ft.	....	20 June 1962	(9)
64	Huber: population...estimated at between 150 and 300 birds / (Haleakala Crater)	....	12, 13, 15 May 1964	(10)
65	King: unlikely that the population...exceeds 1,000 pairs / (Haleakala Crater)	....	12-16 May 1964	(11)
66	Huber: estimated 150 / (Haleakala Crater)	....	May 1964	(12)
67	Gill & Huber: population...desperately low, doubtfully exceeding 75 individuals / (Haleakala Crater)	....	4-7 Aug. 1964	(13)
68	Banko: four specimens salvaged (one by Huber) / (Haleakala Crater)	....	1964	(7)
69	King: heard a few...not as plentiful as at Holua Cabin / vicinity Kapalaoa cabin	....	15 May 1964	(3)
70	Huber: estimated 25-50 / unspecified locality, Haleakala Crater	....	Sept.? 1964	(12)

71	Huber: estimated 150 / unspecified locality, Haleakala Crater	....	Sept.? 1964	(12)
72	Banko: four specimens obtained / (Haleakala Crater)	....	1964	(7)
73	15 total known burrows, 47 percent active / (Haleakala Crater)	....	1966	KJAJ78
74	Larson: at least a hundred pairs / Kapalaoa Pali	....	(1965-1966)	(14)
75	Larson: at least 300 breeding pairs / Leleiwi and Kalahaku Palis	....	(1965-1966)	(14)
76	15 total known burrows / (Haleakala Crater)	....	1967	KJAJ78
77	15 total known burrows, 60 percent active / (Haleakala Crater)	....	1968	KJAJ78
78	36 total known burrows, 39 percent active, 3 dead adults recovered / (Haleakala Crater)	....	1969	KJAJ78
79	King: from nocturnal vigils to determine the location and frequency of calls, and diurnal searches for burrows...estimate yields 355 burrows which are probably being used by breeding pairs...total of 710 paired breeders and a slightly greater number of nonbreeders yields a total of about 1500... in the population / Haleakala Crater... 22 sq. miles...searches for burrows could only be carried out effectively when it was determined beforehand that an area had birds calling over it at night	....	10 June-2 Sept. 1970	(15)
80	226 total known burrows, 95 percent active, 1 dead adult recovered / (Haleakala Crater)	....	1970	KJAJ78
81	113 burrows checked, 71 percent active, 1 dead adult, 2 dead juveniles recovered / (Haleakala Crater)	....	1971	KJAJ78

Island of Maui--(Continued)

Hale Nat'l. Park (con't.)

82	Kunioki: total of 132 petrel burrow sites were relocated and checked...not possible to locate 50 petrel nests that were found and numbered by King in 1970...in addition 41 new burrows were found...total of 173 burrows observed, 90% appeared to have been active and 10% inactive or abandoned / survey along the West (Haleakala) Crater Rim from White Hill to Kilohana...observations were devoted primarily to traversing the cliff and slopes of the West Rim to check the burrow sites, note activity status of each nest site and record the locations onto maps ...most effort was in trying to relocate the petrel burrow sites from the previous year and to pin-point the exact locations to record...on topo maps...all observations were conducted during the day with no night postings or observations	....	15 May-27 Aug. 1971	(16)
83	population numbers about 1800...calculated from surveys...an apparent increase since 1970 / (Haleakala Crater)	....	14 June-13 Aug. 1972	BUXK73
84	344 total known burrows, 82 percent active, 1 dead adult, 3 dead juveniles recovered / (Haleakala Crater)	....	1972	KJAJ78
85	344 total known burrows, 76 percent active, 3 dead adults, 1 dead juvenile recovered / (Haleakala Crater)	....	1973	KJAJ78
86	344 total known burrows, 62 percent active, 3 dead adults, zero dead juveniles recovered / (Haleakala Crater)	....	1974	KJAJ78
87	362 total known burrows, 65 percent active, 2 dead adults, zero dead juveniles recovered	....	1975	KJAJ78

88	428 total known burrows, 67 percent active, 6 dead adults, zero dead juveniles recovered / (Haleakala Crater)	....	1976	KJAJ78
89	437 total known burrows, 71 percent active, 2 dead adults, zero dead juveniles recovered / (Haleakala Crater)	....	1977	KJAJ78
90	primary nesting areas / Kilohana Pali and White Hill	....	(1966-1977)	KJAJ78
91	total population including juveniles esti- mated at 1600'500 / (Haleakala Crater)	....	(1977)	KJAJ78
92	99% of all known active burrows (Haleakala Crater) in KILOHANA QUAD.	....	(1978)	(24)

LAHAINA

93	disabled adult picked up / Lahaina Highway	....	27 Oct. 1976	(17)
94	disabled adult picked up / Lahaina	....	29 Oct. 1976	(17)

WAILUKU

95	Kunioki: disabled immature picked up / Wailuku Dairy Queen	....	23 Oct. 1976	(17)
96	Kunioki: disabled immature picked up / backyard of residence, Kahului	....	23 Oct. 1976	(17)
97	Kunioki: disabled immature picked up / Papa Street, Kahului	....	24 Oct. 1976	(17)

Island of Maui--(Continued)

WAILUKU (con't.)

98	Kunioki: disabled immature picked up / Kahului football stadium	....	24 Oct. 1976	(17)
99	Kunioki: disabled immature picked up / Wailuku	....	24 Oct. 1976	(17)
100	Kunioki: disabled immature picked up / Kaahumanu Shopping Center, Kahului	....	25 Oct. 1976	(17)

Island of Hawai'i

Kohala

KAWAIHAE

101	Banko: long-term residents Richards and Wall reported hearing or seeing nothing resembling 'Ua'u / Kahua Ranch	....	1955-1968	(1)
102	Banko: listened for an hour or two after dark...very windy...none heard / camp S of Puu Pili; Kahua Ranch	....	20 May 1968	(1)
103	Banko: listened for an hour or two after dark...none heard / camp near Puu Laalaau, head of W branch Honokane Nui, N Kohala Mtns.	3840	21 May 1968	(1)

KAMUELA

104	Banko: none heard 1930-2040 hours / Forestry Road overlooking Waipio Valley 4 miles N of Kamuela	11 Aug. 1967	(1)
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Kona

HUALALAI

- | | | | | |
|-----|--|---------------|--------------|-----|
| 105 | Banko: listened for calling of 'Ua'u without success 2000-2200 hours / Hualalai crater complex (Nawahine) | 7400,
7600 | 26 June 1967 | (1) |
| 106 | Banko: Santos collected bones of this species (presumably middens of early Hawaiians) / lava cave near Ahua Umi Heiau, Hualalai - Mauna Loa saddle area | .... | (1970) | (6) |

KAUNENE

- | | | | | |
|-----|--|----------|--------------|--------|
| 107 | passed the skin of a petrel lying on trail ...native guide said it was a 'Ua'u / Honaunau, Mauna Loa | ca. 4500 | 16 Nov. 1891 | MUNG41 |
|-----|--|----------|--------------|--------|

PAPA

- | | | | | |
|-----|--|------|--|-----|
| 108 | Banko: persistent night calling heard on initial and all subsequent visits; entire volcanic complex searched in 1967, finding only one active burrow (which was subsequently occupied in 1968 and 1972; unchecked in 1969, 1970, and 1971) / unnamed red cinder cone, and crater complex, 0.75 mile SE of Puu Ohohia, SW Rift, Mauna Loa | 5536 | 18 May, 29 June 1967;
8-9 July 1968;
21 July, 1 Sept. 1972 | (1) |
|-----|--|------|--|-----|

Ka'u

PUU O UO

- | | | | | |
|-----|---|------|--------------|-----|
| 109 | Banko: negative daytime search for burrows / Puu O Uo volcanic cone and crater complex NW slope Mauna Loa | 8846 | 13 June 1967 | (1) |
|-----|---|------|--------------|-----|

Island of Hawai'i--(Continued)

PUU ULAULA

110	Lockwood: heard night calling of birds an hour or so after dark (? 'Ua' u) / volcanic cone on NE Rift Mauna Loa	7996	28 July 1976	(1)
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111				
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KULANI

112	Banko: one specimen salvaged / Kulani (Project)	5500	28 Nov. 1954	(7)
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ALIKA CONE

113	Banko: only one night-time call heard locally; sporadic calling heard distantly up-Rift of Puu O Keokeo / 1 mile NW of Puu O Keokeo	6800	9 July 1968	(1)
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114	Banko: heard none listening 2000-2030 hours / Kipuka Nene 2-3 miles SE of SW Rift cracks and cones, Mauna Loa	8300	25 July 1968	(1)
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115	Banko: only one night-time call heard on each visit / volcanic cone and crater complex 2.5 miles N of Puu O Keokeo, SW Rift, Mauna Loa	7367	10 July 1968 27 Aug. 1973	(1)
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116	Banko: no calls heard all evening to 2113 hours / volcanic cone and crater complex adjacent to Great Crack, SW Rift, Mauna Loa	9700	25 Aug. 1973	(1)
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|-----|--|------|--------------|-----|
| 117 | Banko: no calls heard from dusk to 2218 hours / volcanic cone and crater complex adjacent to Great Crack, SW Rift, Mauna Loa | 8000 | 26 Aug. 1973 | (1) |
| 118 | Banko: none heard in three 1-mile apart night-time listening stations / starting 4 miles S of unnamed red cinder cone and crater complex (0.75 mile SE of Puu Ohohia) to within 1 mile of base of cone | 5536 | 8 July 1968 | (1) |

PUU KEOKEO

- | | | | | |
|-----|---|------|---|-----|
| 119 | Banko: persistent night calling heard...one burrow near summit active in 1968, 1972; one burrow near base (maikai) of cone active in 1968 / Puu O Keokeo volcanic cone and crater complex, SW Rift, Mauna Loa | 6875 | 28 June, 11 July 1967;
12 June, 9 July 1968;
28 Aug. 1973 | (1) |
| 120 | Banko: persistent night calling heard 1945-2107 hours...no burrow found / volcanic cone and crater complex ca. 1.5 miles down SW Rift from Puu Keokeo, Mauna Loa | .... | 14 Aug. 1967 | (1) |
| 121 | Banko: only a few calls heard from 2006-2230 hours / volcanic cone 1.5 miles NE of Puu Keokeo | .... | 25 June 1968 | (1) |
| 122 | Banko: no calls heard all evening to 2040 hours / volcanic cone about 4 miles NE Puu Keokeo | .... | 26 June 1968 | (1) |

Island of Hawai'i--(Continued)

NAALEHU

- 123 Banko: Meinecke (born about 1886 in Waiohinu): night calling of petrels formerly heard from birds presumably nesting at nearby Pali Puao (KAHUKU RANCH QUAD.)...when a lad of only 6 or 8 years (about 1894) old timers told Meinecke of the 'A'o nesting in numbers at Pali Puao before it collapsed in great earthquake of 1868...however Meinecke accurately imitated calling of 'Ua'u in my presence and was not familiar with appearance of either species. The historical record is therefor confused - possibly 'Ua'u nested at Pali Puao or in conjunction with 'A'o / Waiohinu (NAALEHU QUAD.)
- about 1894 (1)

Kilauea

KAPOHO

- 124 Nakamura: saw small flock / near Malama-Ki
- Nov. (1951) BALH52

Hawaii Volcanoes
National Park

PUU ULAULA

- 125 Banko: none heard in night survey 2005-2020 hours / Puu Ulaula (Red Hill) 10,092 5 June 1967 (6)
- 126 Conant: Corn picked up three partial specimens / about 0.25 mile NE Mauna Loa Trail 7700 late June 1975 (25)

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|-----|---|----------|-----------------|------|
| 127 | Banko: NPS trail crew members Fontes and Nishimoto: found feathers and bill (identified as those of 'Ua'u by Banko) / along Mauna Loa trail, above Strip Road | ca. 8000 | 11 Nov. 1976 | (1) |
| 128 | presence revealed (? heard) / Mauna Loa summit trail | ca. 8000 | 28-30 July 1978 | (26) |

MAUNA LOA

- | | | | | |
|-----|---|---------|-------------|-----|
| 129 | W. & P. Banko: none heard in night survey / Mokuweoweo Crater, W and E summit rims, Mauna Loa | 13,500+ | 7 Aug. 1967 | (6) |
|-----|---|---------|-------------|-----|

KILAUEA CRATER

- | | | | | |
|-----|---|------|------------------|--------|
| 130 | downy young obtained from a native, told that a considerable number had their nests in holes in the ground in the vicinity / Kilauea...and more particularly on the slopes of Mauna Loa | .... | Sept. 1887 | WILS99 |
| 131 | one caught alive / N rim of Kilauea caldera | 4000 | 8 Nov. 1948 | BALP49 |
| 132 | NPS: young bird picked up alive / Kailauea Military Camp | 4000 | (late Nov. 1949) | (2) |
| 133 | believed heard at night / Volcano House | 4000 | 18 June (1960) | DUNW60 |
| 134 | repeatedly heard...probably this species / Volcano House | 4000 | 18 June 1960 | EISE61 |
| 135 | King: unsuccessful night survey / Kilauea Iki, Halemaumau, Chain of Craters | 3800 | 18 April 1964 | (3) |

Island of Hawai'i--(Continued)

35

KILAUEA CRATER (con't.)

136	Morrison: heard...surprised at the sound - to my ear more of a nervous chattering than the wailing sound I have heard described / (Kilauea Crater)	4000	28-29 April 1967	HATG67
137	Morrison: believe April 1967 records in error / (Kilauea Crater)	4000	(27 Sept. 1967)	MORG67
138	Banko: Hansen brought in specimen found dead on Belt Highway / 47 mile post (about 7 miles SW of Park boundary)	....	22 Oct. 1967	(1)
139	Banko: none heard in night survey / Kilauea Crater	4000	25 May 1968	(1)
140	Banko: Forbes picked up one immature bird / Kilauea Military Camp	4000	18 Nov. 1968	(1)
141	Banko: specimen captured 2000 hours / flew into USGS Volcano Observatory window...night calm, ground fog	4000	13 May 1969	(1)
142	Banko: one immature picked up on ground; heavy overcast weather / Kilauea Military Camp	4000	28 Nov. 1972	(1)
143	Banko: Lockwood picked up immature live specimen / found on ground near the Volcano House	4000	19 Nov. 1974	(1)
144	Banko: Linderer picked up immature live specimen / Volcano House	4000	11 Nov. 1976	(1)
145	van Riper: one adult picked up / struck Volcano House during night	4000	12 Nov. 1977	(4)

KAU DESERT

146	Banko: negative daytime search for burrows / Mauna Iki, Puu Koae cone, pit craters and basalt cliffs E and S of Puu Koae	3250	25 May 1967	(1)
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MAKAOPUHI CRATER

147	Banko: several calls heard 1920-2100 hours / N mezzanine Makaopuhi Crater	3000	7 Sept. 1972	
148	Baldwin: may have been present...seems very reasonable to me that population found in 1972 may be a relict group	3000	(1940's)	(5)
149	Banko: obtained carcass found dead by USGS field party...specimen had broken wing and burned feathers / within 3 ft. of edge of erupting crater, Mauna Ulu	....	1 Dec. 1972	(1)
150	Banko: none heard in listening survey from dark to 2030 hours...windy, drizzling rain / SE rim Makaopuhi Crater	3000	6 Aug. 1978	(1)

Mauna Kea

UMIKOA

151	heard uttering its peculiar call from a nearby hill after dark / (Kaluamakani cabin)	7000	July 1962	WALR62
152	Banko: none heard during 26 5-minute listening periods, 0.5 mile interval stop survey...2000-2400 hours / along State jeep trail on N and W slopes of Mauna Kea, from Puu Kanakaleonui to near Kemole (MAKAHALAU QUAD.)	(ca. 9000)	3 May 1968	(1)

Island of Hawai'i--(Continued)

37

AHUMOA

153	Banko: none heard during 11 5-minute listening periods, 0.5 mile interval stops, 2015-2115 hours / starting at 10,100 ft. el. at end of State jeep trail on W slope of Mauna Kea down to Puu Laau 7900 ft. el.	3 July 1968	(1)
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MAUNA KEA

154	to owners belong sole privilege of capturing 'ua'u / land of Hamakua (Mauna Kea)	(1875)	LYOC75
155	complete dead specimen found / near Kanaka-leonui...on the E slope of Mauna Kea	9400	29 April 1954	RICF54
156	five fresh burrows found / near Puu Kole... SE slope of Mauna Kea	8800	12 June 1954	RICF54
157	Ferberstrom obtained remains of three / above 9000 ft. on the E slopes of Mauna Kea (Puu Kole area)	8800	Spring of 1954	RICF54
158	feathers and part of beak found / on S slope of Mauna Kea	ca. 10,000	Spring of 1954	RICF54
159	many bones found with Hawaiian artifacts / Hopukane Shelter Cave, S side of Mauna Kea	ca. 10,000	(1954)	RICF54
159a	one of featured foods found in middens of early Hawaiians dated tentatively A.D. 1264 to 1657 / adze quarry sites, S slopes Mauna Kea	11,000- 12,400	(1975/1976)	MCCP77
160	Banko: picked up old wing; confirmed as 'Ua'u later by Banks and Laybourne, USNM / State Forestry cabin below Puu Kanakaleonui	9400	29 May 1968	(5)

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|-----|---|-----------------|--|-----|
| 161 | Banko: none heard during 20 5-minute listening periods, 2015-2300 hours, half-mile interval stops / along State Fish & Game jeep road on E slope Mauna Kea, from near Puu Kole 10 miles to camp at Puu Kanakaleonui | 8800-
9400 | 29 May 1968 | (1) |
| 162 | Banko: none heard during 17 5-minute listening periods, 2015-2155 hours, 300 ft. el. interval stops / starting at 12,000 ft. el. on summit road down to Hale Pohaku construction camp 9200 ft. el. | .... | 2 July 1968 | (1) |
| 163 | Banko: Crapo (construction foreman for first Mauna Kea telescope): heard and saw no birds resembling 'Ua'u / Hale Pohaku construction camp and along access road to summit of Mauna Kea | 9200-
13,500 | April-June 1968
(interview of
2 July 1968) | (1) |
| 164 | Banko: Crapo saw and heard nothing of 'Ua'u since interview of 2 July 1968 / Hale Pohaku to site of observatory construction, summit of Mauna Kea | 9200-
13,500 | 22 Aug. 1969 | (1) |
| 165 | Banko: negative results for four 10-minute listening stations, 1945-2044 hours / along jeep trail E flank Mauna Kea beginning at 8800 and ending 9400 ft. el. switchback area above Puu Kole | .... | 15 June 1969 | (6) |
| 166 | Banko: negative results during three 5-minute night listening periods / site of 'Ua'u burrows located by Fergustrom in 1954, and along State Fish & Game jeep road 0.5 on either side (above Puu Kole) | (ca. 8800) | 22 Aug. 1969 | (1) |
| 167 | Banko: Santos brought in old dried-up carcass picked up / black sand flats 0.25 mile S of Kanakaleonui | 9400 | 28 Oct. 1969 | (1) |

Island of Hawai'i--(Continued)

MAUNA KEA (con't.)

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|-----|---|---------------------------------|--------------|-----|
| 168 | Banko: heard rush of wings and one call of 'Ua'u at 1935; two calls at 1942, several more weak calls at 1950 hours toward Kanakaleonui cone / 500 yards S Kanakaleonui | 9400 | 2 June 1970 | (1) |
| 169 | Banko: listened 2003 to 2015 hours hearing one clear 'Ua'u call / 1.25 miles S of Kanakaleonui | 9000 | 2 June 1970 | (1) |
| 170 | Banko: heard none in four 10-minute listening periods at 1 mile interval stops, from 2022 to 2130 hours / 2.25, 3.25, 4.24, 5.25 miles S of Kanakaleonui | 8900,
8700,
8800,
9100 | 2 June 1970 | (1) |
| 171 | Banko: none heard in four 10-minute listening periods at 0.5 mile interval stops, 1945-2044 hours / N along State Fish & Game jeep road starting W of unnamed volcanic cone N of Puu Kole | 8800,
9000,
9300,
9400 | 15 June 1970 | (1) |

NAOHUELEELUA

- | | | | | |
|-----|--|--------|-------------|--------|
| 172 | remains of five found...fragile...skeletons nearly complete...not recent / on floor of lava tube edge of 1859 lava flow, Grid 18-73, Impact Area, Pohakuloa Training Area (U. S. Army) | 1..... | (1976-1977) | SHAR77 |
| 173 | leg and sterna bone middens in lava tube apparently used as sleeping cave by early Hawaiians / Grid 16, 17-81, 82, Area 7, P. T. A. (U. S. Army) | ..... | (1976-1977) | SHAR77 |

PUU OO

174	natives report formerly...nested in great numbers / in the lave between Mauna Kea and Mauna Loa	(1894-1902)	HENH02
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HILO

175	specimen obtained / Hilo beach	20 Nov. 1890	HENH02
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176	feel reasonably sure ('Ua'u) is mysterious visitor which has periodically invaded town of Hilo upon dark and stormy nights...harsh snarling cries...heard intermittently all night long...over the zone of light...usually during the fall and winter months...white underparts convince...beyond much doubt that this bird is none other than one of the petrels...some natives declare it is 'ua'u...others...'ao...koae...never seen by human eye...attempts to secure specimen futile / Hilo	(1890's)	HENH02
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177	Banko: Shipman (resident of Hilo area since 1892) never saw an 'Ua'u but as a lad recalled mother telling of natives claiming different caves or nesting areas for capturing young for food / undesignated localities	(1900's)	(1)
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178	heard many...I think this species...more than ever before / (Hilo)	9 April 1946	BALH46
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At Sea

179	natives reported common / on a fishing ground some five to ten miles off...windward Hawaii	(1894-1902)	HENH02
180	distribution map (compiled from 3,561 hours observation on 15 cruise surveys along 34,384 mile replicate sampling track 1964-1965 indicates a density center in the NW corner of the area / near lat. 25°N, long. 157°W (in 500,000 sq. mile study area, between about 10°-27°N lat., and 148°-158°W long.)	....	(1964-1965)	KINW70
181	observed on surveys / N to 42°N lat.	....	(1964-1965)	KINW67
182	observed on surveys / S to 5°N lat.	....	(1964-1965)	KINW67
183	individuals seen on surveys / as far S as lat. 11° N, as far E as long. 148°W, and as far N as lat. 25°N	....	(1964-1965)	KINW70
184	determined from surveys that species doubtless ranges / beyond the edges of the (10°-27°N lat. and 148°-158°W long.) study area in all directions	....	(1964-1965)	KINW70
185	King: Crossin saw in company with 'A'o / close to southern shore of Kauai...Pacific Biological Survey Program, Smithsonian Institution	....	early morning (1965-1966)	(22)
186	King: numerous pelagic records / flying directly toward or away from Kauai a few miles offshore	....	(1965-1966)	(21)
187	Banko: Tokumine (Skipper of fishing vessel Kaimamala out of Hilo) identified 'Ua'u from specimen showed him, gave it the Japanese	....	(15 July 1968)	(1)

name "mitaru", and said it was present in
offshore Hawaiian waters from May to October
...gone the rest of year / commercial fishing
grounds from South Point, Hawaii, to French
Frigate Shoals

Extra-Limital

188 a specimen / from the Molucca (Islands)
indicates a migration to the Western Pacific
during the contranuptial season

.... (no date given)

KINW67